INSTRUCTIONAL STRATEGIES, MATHEMATICAL ABILITY, MODE OF ENTRY, AND GENDER AS CORRELATES OF PRE-SERVICE TEACHERS' PERFORMANCE IN INTEGRATED SCIENCE IN NIGERIAN COLLEGES OF EDUCATION

Aminat Aderonke Agoro
Emmanuel Alayande College of Education, Oyo State
Nigeria

Abstract: *The declining rate of pre-service teachers' performance in integrated science has continuously engaged the attention and concern of stakeholders in Nigeria. Many reasons have been adduced, but effectiveness of instructional strategies adopted by lecturers and other student variables stand out. As panacea, researches have focused on collaborative teaching and self-regulation strategies without considering opportunity for peer instruction coupled with reflection before, during, and after lessons for subsequent adjustment and improvement in a rapidly changing classroom situation and student characteristics. An ex post facto type of descriptive design was used to explore the relationship among the variables involved in the study using 294 pre-service teachers purposively selected from six colleges of education in southwest Nigeria. Five instruments were developed, namely: Pre-service Teachers' Achievement Test ($r_{=}0.85$); Pre-Service Teachers' Numerical Ability Test ($r_{=}0.79$); Operational Guides for RRT, RRPT and Modified Conventional Teaching Strategy ($r_{=}0.75$, 0.72 and 0.77 respectively). Three hypotheses were tested at 0.05 level of significance. Data were subjected to Pearson product-moment correlation and multiple regression. Results showed that instructional strategy ($r=.305$; $p<.05$) and mathematical ability ($r=.05$; $p>.05$) have positive significant relationship with pre-service teachers' performance in integrated science. On the other hand, mode of entry has no significant relationship ($r=.94$;$p>.05$) with the dependent variables. All the four factors jointly correlate positively with the pre-service teachers' performance in integrated science ($R=.377$). From the four factors mathematical ability made the highest contribution ($\beta=.221$) followed by instructional strategy ($\beta=.217$), then sex ($\beta=.074$), while mode of entry made the lowest contribution. It was recommended that peer instructional strategies coupled with reflection before, during, and after lessons should be encouraged in the teaching methodology course during the training period. Also, stakeholders should encourage pre-service teachers to improve upon their mathematics skills as this would go a long way to improving their performance and teaching skills in integrated science.*

Keywords: instructional strategy, mathematical ability, pre-service teachers, gender, mode of entry

Introduction

Integrated science study started in Nigerian Colleges of Education (NCE) in 1990-1991 session. Today, integrated science is offered in all colleges of education in Nigeria. The course has helped in producing manpower for the teaching of basic science at the primary and junior secondary school levels of education. However, research reports show that the programme has not been quite successful (Olarewaju, 1996). Some reasons were adduced for the poor performance in the subject. These range from student factors like their poor attitudes towards science (Showers & Shrigley, 1995), lack of interest in science (Adepitan, 2003), lack of role models in the subject (Ivowi & Oludotun, 2001), and

poor mathematical background (Ogunleye, 2001). Government factors were also identified in the area of policy making, infrastructural provision, and teacher welfare (Ogunleye, 2001), as were teacher factors such as teaching methods employed (Adepitan, 2003; Kalijah, 2000) and unhealthy teacher-student relationship (Aysan, 1996).

There seems to be a general consensus of opinion among science educators concerning the vital role played by teaching methods or instructional strategies adopted by the teacher as these and other variables affect students' achievement and attitudes to science (Gbolagade, 2009). He emphasized the importance of appropriate teaching method in the development of skills required for making science content relevant to the growth and development of both the individual and the society and called for the adequate training of teachers, which should include the introduction of appropriate methods for teaching the subject-matter. Iroegbu (1998) observed that learners tend to derive maximum benefits in learning cognitive skills when the teaching strategy adopted involves the use of a mixture of different methods, while at the same time, creating opportunities for the learners to practice skills as a meaningful whole. Learners must, therefore, be exposed to situations that demand the knowledge and skills they are required to acquire and use. Many instructional strategies have been developed and found effective in teaching science. Examples are the collaborative group strategies for pre-service teachers (Gbolagade, 2009; Adedigba, 2002); problem solving and concept mapping (Orji, 1998); reform-based instruction (Barak & Shakhman, 2008); meta-cognition strategy (Eldar, Eylon, & Ronen, 2008); self-regulation strategy (Arsal, 2010); and predict-observe-explain strategies (Babajide, 2010) to mention but a few.

In spite of all these efforts towards improved teaching strategies, the performance of pre-service teachers in integrated science is still very low. Students need to be given opportunity to be actively involved in the learning process (Duyilemi, 2005). Teaching is not simply standing in front of a class talking; the best teachers contemplate the manner in which they will present a topic and have a wide variety of instructional models at their disposal (Orlich, Harder, Callahn, Trevisan & Brown, 2010). It is, therefore, imperative to search for instructional models that could appeal to learners and arouse their interest and at the same time help to achieve the objectives of science education.

To achieve the desired educational goals, teachers need to reflect on their teaching goals and how these interface with the demographics and abilities of their students. This process will, according to Clarke (2007), allow teachers to clarify their knowledge base, the content, and their students' learning styles. In choosing instructional strategies, teachers need to consider the challenges that the students may encounter and strategies to assist the students in overcoming them. After the lesson, teachers need to evaluate the lesson goals and the action of both themselves and their students as well as define the point at which difficulties emerged. Reflective teaching is a model that is grounded in constructivism and metacognition in which students and teachers are exposed to teaching and learning experience under the scrutiny of their peers and mentor or college supervisor who critiques their ideas (Clarke).

Reflection, according to Clarke (2007), refers to thinking about the actual teaching which involves the thought teachers have before, during, and after a lesson. This teaching strategy has not been given adequate attention in classrooms,

especially in science related subjects. Perhaps, however, it could be used to achieve the objectives of the basic science curriculum. At the pre-service level, it will be useful to train teachers who would adopt the strategy when they will be practicing later in their career. It is a means of professional development which begins in our classroom. It is paying critical attention to the practical values and theories which inform everyday action by examining practice reflectively and reflexively (Bolton, 2010). It involves the consideration of the ethical consequences of classroom procedure on students (Larrivee, 2000). As teaching and learning are complex, and there is not one single right approach, reflecting on different versions of teaching and reshaping past and current experience will lead to improvement in teaching practices. Reflective teaching is in three phases: the planning phase, teaching phase, and the debriefing phase. During the planning stage the teacher must use strategy(ies) like cooperative learning techniques, hands-on activities and so on (Clarke, 2007). Based on these, the researcher used two cooperative learning strategies with reflective teaching.

Reciprocal teaching (RT) is a student-centered instructional strategy in which students and teachers switch roles in a lesson. It is a cooperative learning instructional method in which natural dialogues model reveal learners' thinking processes about a shared learning experience (Foster & Rotoloni, 2005). Teachers foster reciprocal teaching through their belief that collaborative construction of meaning between themselves and students lead to a higher quality of learning (Allen, 2003). Students take ownership of their role in reciprocal teaching as they feel comfortable expressing their ideas and opinions in open dialogue. They take turns articulating with the learning strategy. The learning community is able to reinforce understanding and to see, hear, and correct misconceptions that otherwise might not have been apparent. All members of the community have shared responsibility for leading and taking part in dialogue during learning experience (Hashey & Connor, 2003).

Reciprocal peer tutoring (RPT) is also an intervention in which one student provides instruction or academic assistance to another student. RPT is a form of cooperative learning, which has been found to be an effective technique for increasing students' academic achievement (Sharman, 1991; Slavin, 1991). Conceptually, RPT is similar to many activities ranging from the informal encounters of play to the most complex activities of cooperation in which people help one another and learn by doing so. This process transforms learning from a private to a social activity by making learners responsible for their own learning and that of others. Researchers have shown that both tutors and tutees gain immensely from participating in reciprocal peer tutoring (Forman, 1994; Griffin & Griffin, 1997; Slavin, 1991). In this process, students function reciprocally as both tutors and tutees. This dual role is beneficial because it enables students to gain from both the preparation and instruction in which tutors are engaged and from the instructions that tutees received (Griffin & Griffin, 1997).

The mode of entry of students into the NCE programme is an index of students' previous knowledge or entry behavior and based on student performance in an earlier examination. The Joint Admission and Matriculation Board (JAMB) was established by the federal government of Nigeria in 1978 to regularize the intake of students into universities and later polytechnics, monotechnics, and colleges of education to solve the problem of multiple admission given to some candidates at the expense of others

(JAMB, 1998). The mode of entry into the NCE programme is in two forms: direct entry which is handled by JAMB and through prelimary studies which is the mode handled by the colleges of education themselves. The opinion is that a prediction of a future examination result could be made with reasonable success on the basis of the result of an earlier examination and that grade may serve as predictive measure and as a criteria measure (Daniels & Schouten, 1978 as cited by Adeyemi, 2009).

Numerical ability of the pre-service science teachers is an important factor in effective science teaching. Studies have shown that numerical skills are necessary factors that support mathematics and science achievement. Nunnally (2004) defines numerical ability as the ability to solve problems in number sequencing, make accurate mathematical deductions through advanced numerical reasoning, interpret complex data presented in various graphical forms, deduce information, and draw logical conclusions. Numerical ability test is designed to measure the students' ability to use numbers to correctly solve problems. Such tests according to Olatoye, Aderogba, & Aanu (2011) signify basic arithmetic prowess in an individual and can be given directly to candidates or administered as subsets of other tests.

Gender has become an issue affecting performance of pre-service teachers in science generally (Agoro, 2002). It has been issue of concern to researchers and educators (Longe & Adedeji, 2003). Yet, studies on the influence of students' gender on academic performance have not produced conclusive results. Some findings indicate that a significant difference exists between performance of male and female students (Agoro, 2002; Akande, 2002) while other findings show that gender has no influence on students' performance (Ajanaku & Aremu, 2006; Jimoh 2004; Raimi & Adeoye, 2002). Longe & Adedeji (2003) are of the opinion that science and technology is a male dominated subject. Here in lies the need for this study.

Statement of the Problem

Pre-service teachers' poor performance in integrated science has been an issue attracting the attention of researchers and science educators. This is crucial for a subject as important as integrated science and effective teaching and learning of basic science in Nigerian schools. Several factors have been adduced to be responsible for this trend. These include the instructional strategy used in teaching the subject at the NCE level which does not make a good level of performance on the part of the pre-service teachers. Also, the role of mathematics as the language of science has not been given a pride of place in instructional delivery. Studies also show that level of science experience is critical as NCE students enroll either directly from secondary school or after one year pre-NCE science programme.

This study, therefore, explores the relationships among instructional strategy, mathematical ability, mode of entry, and gender on pre-service teachers' achievement in integrated science in Nigerian Colleges of Education.

The following null hypotheses were tested in the course of this study at 0.5 level of significance:

$H_0$1: There is no significant relationship between (a) instructional strategy, (b) mathematical ability, (c) mode of entry, and (d) gender on pre-service teachers' achievement in integrated science.

$H_0$2: There is no significant composite effect of the four factors viz.: instructional strategy, mathematical ability, mode of entry, and gender on

pre-service teachers' achievement in integrated science.

$H_0$3: There is no significant relative effect of each of the four factors (instructional strategy, mathematical ability, mode of entry, and gender) on pre-service teachers' achievement in integrated science.

Methodology

The study explores expo facto type of descriptive design. It is also correlational as it explores the relationships among the variables involved.

Sampling

Two hundred and ninety four NCE II pre-service teachers studying integrated science as teaching subject in 11 government-owned colleges of education (four owned by the federal government while the remaining seven by the state government) in southwestern Nigeria participated in the study. From these colleges, six (three federal and three state) were purposively selected based on their relative distance from one another.

Instruments

Five instruments were used in the study. These include

1. Operational Guide for Reflective-Reciprocal Teaching Strategy (OGRRTS). This instructional guide was developed by the researcher based on the philosophy of cooperative work among learners and reflection on the part of the trained lecturer. This operating guide is made up of four RT strategies of predicting, questioning, clarifying, and summarising. The interrater reliability of the guide was estimated using Scott's π. The interrater reliability index obtained was 0.75.
2. Operational Guide for Reflective-Reciprocal Peer Tutoring Strategy (OGRRPTS). This operational guide developed by the researcher consists of lesson plans based on the steps listed by Utley, Mortweet, and Greenwood (1997) as well as Fuchs and Fuchs (2003). The recommendations given were used to reconstruct the guide and the inter-rater reliability was then estimated using Scott's π. The interrater reliability index obtained was 0.72.
3. Operational Guide for Conventional Teaching Strategy (OGCTS). The instructional guide was self-developed based on the traditional ways of writing lesson notes. The main feature of the guide was general information, the procedure, the teacher, general objectives, content for each lesson, summary, and conclusion. The interrater reliability index obtained was 0.77.
4. Pre-service Teachers' Numerical Ability Test (PTNAT). The instrument was developed by the researcher and the internal consistency of the scores was determined using split-half method. The reliability index obtained was 0.79.
5. Pre-service Teachers' Achievement Test in Integrated Science (PTATIS). This instrument tested the pre-service teachers' intellectual achievement in speed and acceleration, linear momentum work, energy, and power. The test contains fifty multiple-choice objective test items. The reliability of the test item was determined using Kuder-Richardson Formula 20 (KR-20). The KR-20 value of 0.85 was obtained. Space was provided in the answer sheet where the pre-service teachers were asked to indicate their mode of entry into the college (that is, either through direct entry or through preliminary study).

Data Collection Procedure

The researcher personally visited the participating lecturers who are the lecturers handling the course in their respective colleges and trained them on how to implement the steps involved in the guides designed. Two lecturers were trained for each experimental group 1, experimental group 2, and the control group. The training covered one week for each of the three groups. The fourth week was used for pretest administration for all pre-service teachers participating in the study using the achievement test and numerical ability test. The fifth to tenth weeks were used for the implementation of the treatment for each of the two experimental groups and the control group after which the posttest was administered.

Results

Data collected were analyzed using Pearson product-moment correlation and multiple regression.

$H_0$1: There is no significant relationship between (a) instructional strategy, (b) mathematical ability, (c) mode of entry, and (d) gender on pre-service teachers' achievement in integrated science.

Table 1
Correlations of the Independent Variables with Pre-service Teacher's Performance

Factors	Post-achievement	Treatment	Math Ability	Mode	Sex
Pearson-Correlation					
Post-achievement	1.000	.305	.305	.050	.094
Instructional Strategy	.305*	1.000	.369	.089	.048
Mathematical Ability	.305*	.369	. 1.00	.007	.051
Mode of Entry	.050	.089	.007	1.000	.064
Gender	.094	.048	.051	.064	1.00
Sig.					
Post-achievement (1-tailed)		.000	.000	.197	.054
Instructional Strategy	.000		.000	.064	.205
Mathematical Ability	.000	.000		.452	.192
Mode of Entry	.197	.064	.452		.138
Gender	.054	.205	.192	.138	

*Significant at $p<.05$

Table 1 shows that instructional strategy used has significant relationship which is positive with performance in integrated science ($r=.305$; $p<.05$). This means that as instructional strategy improves, pre-service teacher's performance in integrated science also improves. Hypothesis 1a is therefore rejected.

The table also shows that the relationship between pre-service teachers' mathematical ability and their performance in integrated science is positive and significant ($r=.305$; $p<.05$). This means that as mathematical ability improves, performance in integrated science also improves, and hypothesis 1b is rejected. For hypothesis 1c, Table 1 shows that mode of entry has no significant relationship with pre-service teachers' performance in integrated science ($r=.05$; $p>.05$). The hypothesis is not rejected.

The table further shows that pre-service teachers' genders had no significant relationship with their performance in integrated science ($r=.94$; $p>.05$). Hypothesis 1d is not rejected.

$H_0$2: There is no significant composite effect of the four factors viz.: instructional strategy, mathematical ability, mode of entry and gender on pre-service teachers' achievement in integrated science.

Table 2
Composite Effect of the Four Factors on Performance in Integrated Science

R	R Square	Adjusted Square	Std Error for the Estimate
.377	.142	.130	5.4175

Table 2 shows that the 4 factors correlate positively with the pre-service teachers' performance in integrated science (R=.377). They also contributed 13.0% of the total variance in the dependent variable (Adj. R^2= .130). To this end, the four factors are quite relevant in the determination of pre-service teachers' performance in integrated science.

Table 3
Analysis of Variance

Model	Sum of square	*df*	Mean square	*F*	Sig.
Regression	1411.344	4	352.836	12.022	.000*
Residual	8511.246	290	29.349		
Total	9922.590	294			

*Significant at p<.05

Table 3 shows that the R value of .377 obtained in the regression analysis is significant (F=12.022; p<.05). Hence, the R value is not due to decrease. Based on this finding, hypothesis 2 is rejected.

$H_0$3: There is no significant relative effect of each of the four factors (instructional strategy, mathematical ability, mode of entry and gender) on pre-service teachers' achievement in integrated science.

Table 4
Relative Effects of the Four Factors on the Dependent Variable

Factors	Unstandardized coefficients		Standardized coefficients	Rank	t	Sig.
	B	Std. Error	Beta			
(constant)	24.371	2.062			11.819	.000
Instructional Strategy	1.629	.442	.217	2nd	3.681	.000*
Mathematical Ability	.254	.067	.221	1st	3.780	.000*
Mode of Entry	.492	.799	.034	4th	.616	.538
Sex	.988	.727	.074	3rd	1.358	.175

* Significant at p<.05

From Table 4, mathematical ability, made the highest contribution to the pre-service teacher's performance in integrated science (β=.221). This is followed by instructional strategy (β=.217). The third in the ranking is gender (β=.074) while mode of entry made the lowest contribution (β=.034). Of these mathematical ability (B=.254; t=3.780;p<.05) and instructional strategy (B=1.629;t=3.681;p<.05) could predict pre-service teachers' performance in integrated science, and therefore, made significant contributions to the dependent variable.

Hence, hypothesis 3 is rejected for instructional strategy and mathematical

ability but not rejected for sex and mode of entry.

Discussion

The major findings of this study show a positive correlation between mathematical ability and pre-service teachers' performance in integrated science. As the level of mathematical ability increases, the performance of pre-service teachers also increases and vice versa. This implies that mathematical ability has positive influence on pre-service teachers' performance in integrated science. This may be expected in the sense that dynamics, which is the concept used as a physics aspect of integrated science and is quantitative in nature; therefore, students with high numerical skills are likely to record higher performance in it than their counterparts with low numerical ability. Also, this finding reiterates the fact that mathematics being a language of science is highly needed for and students to perform credibly well in science. This result is in agreement with the findings obtained by Emeke and Adegoke (2001) and Adu (2002) that the higher the mathematical ability of students, the better their performance in the physics achievement test.

The findings of this study also revealed that the type of instructional strategy used by the teacher has positive effect on pre-service teachers' performance in integrated science. Pre-service teachers' better performance may be due to the fact that they worked cooperatively with their peers thereby providing the social context for them to actively learn and make deeper connections among facts, concepts, and ideas. This developed their social and communication skills, increased cooperation and tolerance of one another as pre-service teachers were from diverse backgrounds working together to achieve group goals and aspirations. This made learning more permanent. The positive influence of instructional strategy on performance may also be due to the fact that it utilized a group reward system and interdependence that maximized learning and motivation. The pre-service teachers were active learners in the classroom. They took active part in the planning and delivering of the lessons thereby acquitting them with the role of a teacher. This finding is in agreement with earlier research results that found that the instructional strategy used by teacher can have positive effect on students' performance in science (Clarke, 2007; Doolittle, Hicks, Triplett, Nichols, & Young, 2006; Fantuzzo, King, & Heller, 1992; Fuchs & Fuchs, 2003; Griffin & Griffin, 1997; Mayfield & Vollmer, 2007; Slavin, 1991).

The findings of this study also revealed that pre-service teachers' gender does not have effect on their performance in integrated science. This finding supports earlier research results that suggested students' gender does not have any influence on their performance in science (Ajanaku & Aremu, 2006; Jimoh 2004; Raimi & Adeoye, 2002).

Recommendations

Based on the findings of this study, it was recommended that teachers should use effective and innovative strategies which are student center to teach science in other to improve their students' performance. Also such innovative strategies should be used to train pre-service teachers so that they will be familiar with those strategies and find them easy and convenient to use when practicing as a teacher. Pre-service teachers should be encouraged by their teachers to have positive attitude to mathematics as this would help in improving their performance in science.

Governments should organize a form of in-service and re-training programmes for teachers in the effective use of innovative and effective teaching strategies through

organization of seminars, workshops, and conferences for science teachers to improve their teaching skills as well as improving the performance of their students.

References

Adedigba, A. T. (2002). *Two collaborative group strategies and achievement in mathematics in colleges of education*. (Unpublished doctoral dissertation). University of Ibadan, Nigeria.

Adepitan, J. O. (2003). Pattern of enrollment on physics and students' evaluation of the contributory factors on Nigeria colleges of education. African Journal of Education Research 2, 136-146.

Adeyemi, T. O. (2009). Mode of entry as a predictor of success in final year university. *Middle East Journal of Scientific Research, 4*(1), 10-19.

Adu, E. O. (2002). *Two problem-based learning strategies, quantitative ability and gender as determinants of students' academic achievement in economics.* (Unpublished doctoral dissertation). University of Ibadan, Nigeria.

Agoro, A. A. (2002). *Relative effect of instructional strategy, level of commitment and gender on pre-service teachers' learning outcome in integrated science.* (Unpublished master's thesis) University of Ibadan, Nigeria.

Ajanaku J. A., & Aremu A. K. (2006). Gender disparity in quantitative analysis practical among chemistry students in Kwara State College of Education, Oro. *Oro Science Education Journal, 4*(5).

Akande, M. M. (2002). Cultural issues inhibiting women in science, technology and mathematics education. *42nd Annual Conference Proceedings of Science Teachers Association of Nigeria.*

Allen, S. (2003). An analytical comparison of three models of reading strategy instruction. *International Review of Applied Linguistics in Language Teaching, 41*(4), 319-339. doi: 10.1515/iral.2003.015

Arsal, Z. (2010). The effect of diaries on self-regulation strategies of pre-service science teachers. *International Journal of Environmental and Science Education, 5*(1), 85-103.

Aysan, F. I. (1996). Perceived causes of academic failure among the students at the faculty of education at Buca, Turkey. Retrieved from http://files.eric.ed.gov/fulltext/ED406326.pdf

Babajide,V. F. T. (2010). *Generative and predict-observe-explain instructional strategies as determinants of secondary school students' achievement and practical skills in physics.* (Unpublished doctoral dissertation). University of Ibadan, Nigeria.

Barak, M., & Shakhman, L. (2008). Fostering higher-order thinking in science class: Teachers' reflections. *Teachers and Teaching: Theory and Practice, 14*(3), 191-208**.** doi: 10.1080/13540600802006079

Bolton, G. (2010). *Reflective practice: Writing and professional development*. London: Sage.

Clarke, P. A. J. (2007). Reflective teaching model: A tool for motivation, collaboration, self-reflection and innovation in learning. Retrieved from http://coefaculty.valdosta.edu/lschmert/gera/volume%205/Junor-Clarke07Final.pdf

Doolittle, P. E., Hicks, D., Triplett, C. F., Nichols, W. D., & Young, C. A. (2006). Reciprocal teaching for reading comprehension in higher education: A strategy for fostering the deeper understanding of texts. *International Journal of Teaching and Learning in Higher Education, 17*(2), 106-118.

Duyilemi A. N. (2005). The jets programme and the attitude of girls to science and technology in Nigeria. *Educational Thought, 4*(1), 32-38.

Eldar, O., Eylon, B., & Ronen, M. (2008). A metacognitive strategy for training pre-service teachers: Collaborative diagnosis of conceptual understanding in science. *Proceedings of the 8th International Conference of International Society of the Learning Sciences, 3*, 25-26.

Emeke, E. A. & Adegoke, B. A. (2001). The interaction effects of test response mode, students' numerical ability and gender on cognitive achievement in senior secondary school physics. In Y. Awosika, et al. (Eds.), *Topical Issues in Education*: *Papers in Honour of Professor C. O. Udoh*.

Fantuzzo, J. W., King, J. A. & Heller, L. R. (1992). Effects of reciprocal peer tutoring on mathematics and school adjustment: A component analysis. *Journal of Educational Psychology, 84*(3), 331-339.

Forman, F. (1994). Peer collaboration as situated activity: Examples from research on scientific problem solving. In H. C. Foot, C. J. Howe, A. Anderson, A. K. Tolmie, D. A. Warden (Eds.). *Group and Interactive Learning*, (pp. 3-8). Southampton: Computational Mechanics Publications.

Foster, E., & Rotoloni, R. (2005). Reciprocal teaching: General overview of theories. In M. Orey (Ed.), *Emerging perspectives on learning, teaching, and technology*. Retrieved from http://projects.coe.uga.edu/epltt/

Fuchs, D., & Fuchs, L. S. (2003). Peer-assisted learning strategies: Promoting word recognition, fluency, and reading comprehension in young children. *The Journal of Special Education, 39*(1), 34-44.

Gbolagade. R.O. (2009). *The impact of constructivist model based training programmes on pre services' teacher knowledge, attitude, classroom practice and students' teaching outcome in junior secondary school mathematics.* (Unpublished doctoral dissertation). University of Ibadan, Nigeria.

Griffin, B. W., & Griffin, M. M. (1997). The effects of reciprocal peer tutoring on graduate student's achievement, test anxiety and academic self-efficacy. *Journal of Experimental Education* 65 (3), 197-209. doi: 10.1080/00220973.1997.9943454

Hashey, J. M., & Connors, D. J. (2003). Learning from our journal: Reciprocal teaching action research. *Reading Teacher, 57*(3), 224-233.

Iroegbu, T. O. (1998). *Problem based learning, numerical ability and gender and line graphic skills at senior secondary physics in Ibadan.* (Unpublished doctoral dissertation). University of Ibadan, Nigeria.

Ivowi, U. M. O., & Oludotun, J. S. (2001). The students' women in physics in Nigeria. *42nd Annual Conference Proceeding Science Teacher Association of Nigeria.*

Joint Admission and Matriculation Board. (1998). Retrieved from http://www.jamb.gov.ng/home.aspx

Jimoh, A. T. (2004). The influence of gender difference on students' achievement in chemistry. *Nigeria Journal of Gender and Development, 2*(1), 45-51.

Kalijah, T. (2000). Education training and career in physics for woman in Malaysia. In PAP *International Conference on Women in Physics.* UNESCO: Paris, France.

Longe, R. S., & Adedeji, S. O. (2003). Increasing girls' access to technical and vocational education in Nigeria. In O. A. Bamisaiye, L. A. Nwazuoke, & A. Okedara (Eds.), *Millenium Inovations in Theory and Practice*. Nigeria: Macmillian.

Larrivee, B. (2000). Transforming teaching practice: Becoming the critical reflective teacher. *Reflective Practice, 1*(3), 293-307.

Mayfield, K.H. & Vollmer, T.R. (2007). Teaching math skills to at-risk students using home-based peer tutoring. *Journal of Applied Behavior Analysis, 40*(2), 223-237. doi: 10.1901/jaba.2007.108-05

Nunnally, J. O. (2004). *Memory.* New York: Macmillan Press.

Ogunleye, B. O. (2001). Circle perception of strategies for improving low enrolment, under achievement and attitude of girls in physics at the senior secondary school level. *Proceedings of the 42nd annual conference of STAN*.

Olanrewaju, A. O. (1996). Using Nigerian languages as media of instruction to enhance science and technological development. An action delayed. *Fafunwa Foundation Internet Journal of Education.* Retrieved from http://fafunwafoundation.tripod.com/fafunwafoundation/id10.html

Olatoye, R. A., Aderogba, A. A., & Aanu, E. M. (2011). Effect of co-operative and individualized teaching methods on senior secondary school students' achievement in organic chemistry. *The Pacific Journal of Science and Technology, 12*(2), 310-319.

Orji, A.B. (1998). *Effects of problem solving and concept wrapping instructional strategies on students learning outcomes in physics in Ibadan.* (Unpublished doctoral dissertation). University of Ibadan, Nigeria.

Orlich, D. C., Harder, R. J., Callahan, R. C, Trevisan, M. S., & Brown, A. H. (2010). *Teaching strategies. A guide to effective instruction* (9th ed.). Independence, KY, USA: Wadsworth-Cengage Learning.

Raimi, S. M., & Adeoye, A. O. (2002). Gender differences among college students as a determinant of performance in integrated science. *African Journal of Education Research, 8*(1), 2.

Sharman, L. W. (1991). Cooperative learning in post-secondary education: Implications from social psychology for active learning experiences. Retrieved from http://eric.ed.gov/?id=ED330262

Showers, D. E., & Shrigley, R. L. (1995). Effects of knowledge and persuasion on high school students' attitude toward nuclear power plants. *Journal of Research in Science Teaching, 32*(1), 29-43. doi:10.1002/tea.3660320105

Slavin, R. E. (1991). Synthesis of research on cooperative learning. *Educational Leadership, 48*(5), 71-82.

Utley, C. A., Mortweet, S. L., & Greenwood, C. R. (1997). Peer-mediated instruction and interventions. *Focus on Exceptional Children, 29*(5), 1-23.

Author

Aminat Aderonke Agoro, Ph.D., is the Head of the Department of Integrated Science at the Emmanuel Alayande College of Education, Oyo, Nigeria. Her Ph.D. is from the Department of Teacher Education, University of Ibadan, Nigeria in Curriculum and Instruction (Science Education). Her areas of research interest are reflective practice and science education.